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March 28, 2002

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: *Ex Parte* Presentation
IB Docket No. 01-185 (via electronic filing)
File No. SAT-ASG-20010302-00017 et al. (via hand delivery)

Dear Mr. Caton:

Mobile Satellite Ventures Subsidiary LLC ("MSV") hereby files the attached Paper entitled "Monitoring and Control of Ancillary Terrestrial Emissions by MSV's Space Segment" in the record of the above-captioned proceedings.

MSV's request to launch and operate a next-generation mobile-satellite service system (File No. SAT-ASG-20010302-00017 et al.) has been designated as a "permit-but-disclose" proceeding. *See* Report No. SPB-170 (June 26, 2001).

Please direct any questions regarding this matter to the undersigned.

Very truly yours,

David S. Konczal

Document #: 1228053 v.1

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MONITORING AND CONTROL OF ANCILLARY TERRESTRIAL EMISSIONS BY MSV's SPACE SEGMENT

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March 28, 2002

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1. Introduction

MSV's next generation Mobile Satellite System (MSS) will be able to monitor the noise/interference level present within each one of its Space Segment (SS) cells (spot beams) on frequencies that are not used for satellite communications by the SS cell performing the monitoring. Monitoring will be performed by each satellite cell that includes an Ancillary Terrestrial Component (ATC) within its footprint. The purpose of monitoring is twofold:

1) To provide assurance that MSV's own MSS network elements (SS and ATC) are operating with acceptable levels of intra-system interference,

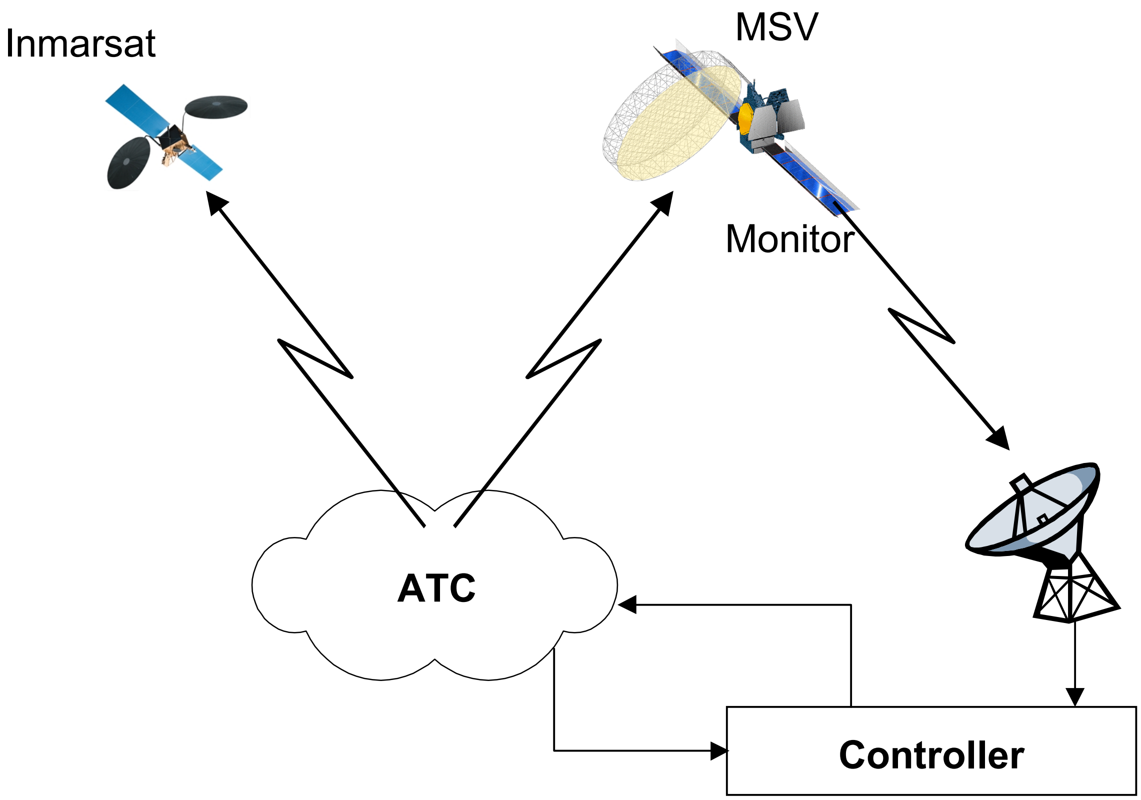
2) To provide assurance that the level of co-channel interference as seen by other systems, such as Inmarsat, remains below acceptable levels.

In accordance with MSV's concept of a fully integrated system, the frequencies used by a satellite cell for satellite communications over its geographic area are not available to the ATC in that same geographic area. Instead, frequencies associated with other (adjacent) satellite cells are made available to that ATC. The integrated MSS system transfers information, in real time, between its SS and ATC and thus knows the frequencies assigned to the ATC and the frequencies that are used for satellite communications within each satellite cell.

Thus, as described in more detail below, the satellite of an integrated MSS system has the intelligence to "distinguish" between two classes of received signals, SS "desired" vs. ATC "undesired" – both occurring within the system's allocated band – and to route the first for communications purposes while processing the second for monitoring. We note that the distinction between the two classes of signals depends entirely on having real time knowledge of the system's frequency plan. Because the system's frequency plan will not, in general, be static but will depend on fluctuations of communications traffic (brought about by predictable and unpredictable events) monitoring and control of ATC emissions can only work in a MSS system that is completely integrated and coordinated between its SS and ATC, with real-time exchange of information between the two.

The aggregate signal level at a particular co-channel frequency generated by ATC operations within each MSV satellite cell will be monitored. This is intra-system, intra-beam monitoring. By combining (summing) the co-channel contributions from all satellite cells containing ATCs, the total (aggregate) co-channel signal generated by the entire ancillary network reaching MSV's satellites will be measured and recorded. Via closed-loop feedback control, MSV's centralized system controller will set appropriate limits on ancillary traffic in the unlikely event that interference begins to approach harmful limits. Figure 1 below is a high-level diagram illustrative of the concept of monitoring and control of ATC emissions by MSV's SS.

FIGURE 1: Monitoring and Control of Ancillary Terrestrial Emissions



Inmarsat in its reply comments has argued that monitoring of the ATC emissions by MSV, for the purpose of protecting Inmarsat's orbital slot at 54° W, may not be effective since there can be significant separation in azimuth between MSV's orbital slot at 101° W and that used by Inmarsat at 54° W. MSV disagrees with Inmarsat's conclusion for the following reason:

There is complete statistical independence between the orientation of urban structures and/or roads and the selection of orbital slots for geo-stationary satellites. A particular orientation and/or geometry for a mall, building, and/or road, relative to a particular location on the geo-stationary arc, is as likely to be encountered as any other. This means that over a wide area, like the United States, all possible morphologies will be encountered by users, some with greater shielding towards the Inmarsat satellite and some with greater shielding towards the MSV satellite. Figures 2 through 4 illustrate the phenomenon. Thus, “everything else being equal”, and given the large randomly distributed ATC user population, the mean ATC emissions strength will be invariant as a function of the geo-stationary orbital slot[1]. However, there is one significant difference between MSV’s satellite at 101° W and Inmarsat’s satellite(s) at 54° W.

The US-wide ensemble of ATC users will see the MSV satellite at 101° W more often than the Inmarsat 4 satellite(s) at 54° W. This is because of the higher elevation angle that the MSV satellite will have relative to that of the Inmarsat 4 satellite(s) at 54° W. The average elevation angle, taken over all US cities for which MSV contemplates ancillary service, is 43° for MSV’s satellite at 101° W and only 30° for the Inmarsat satellite(s) at 54° W.

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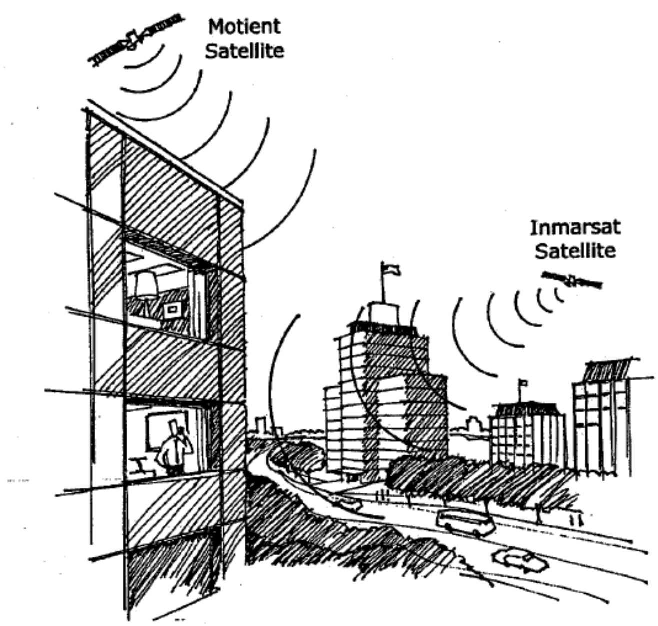
[1] The variance about the mean will be small given the large population of ATC users that is necessary to cause a noticeable co-channel effect.

FIGURE 2: Top illustration provided by Inmarsat; bottom illustration courtesy of MSV



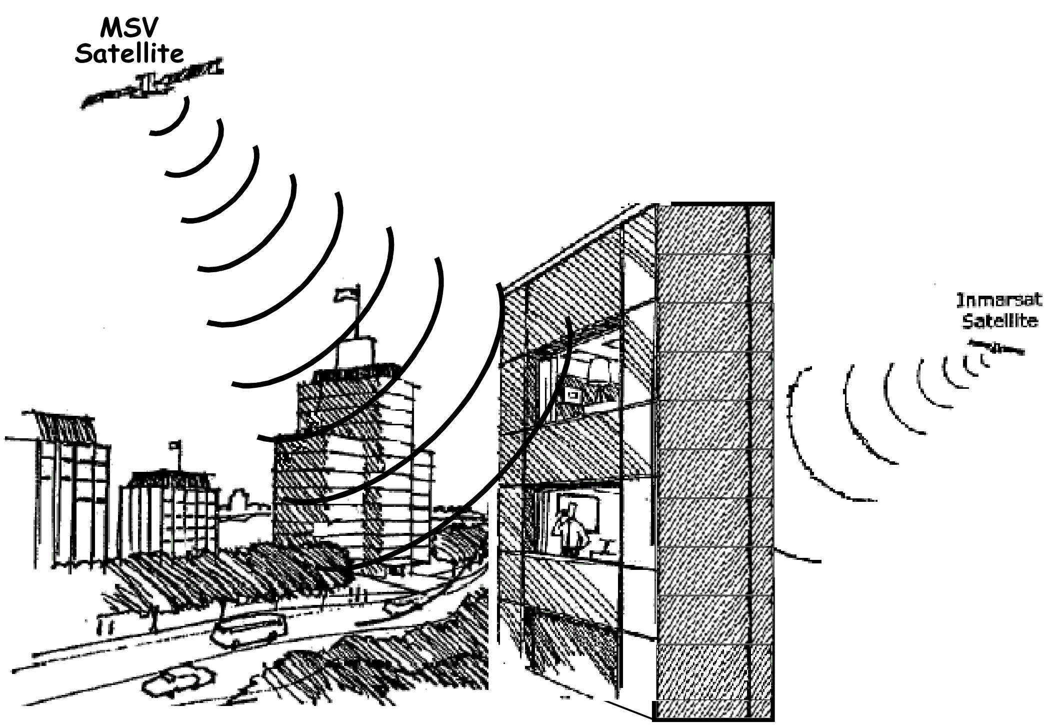
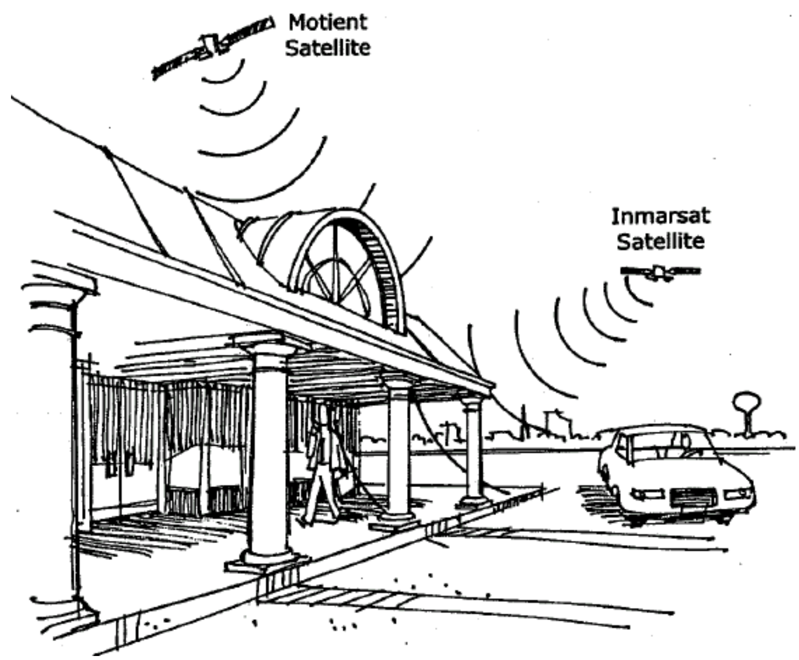


FIGURE 3: Top illustration provided by Inmarsat; bottom illustration courtesy of MSV



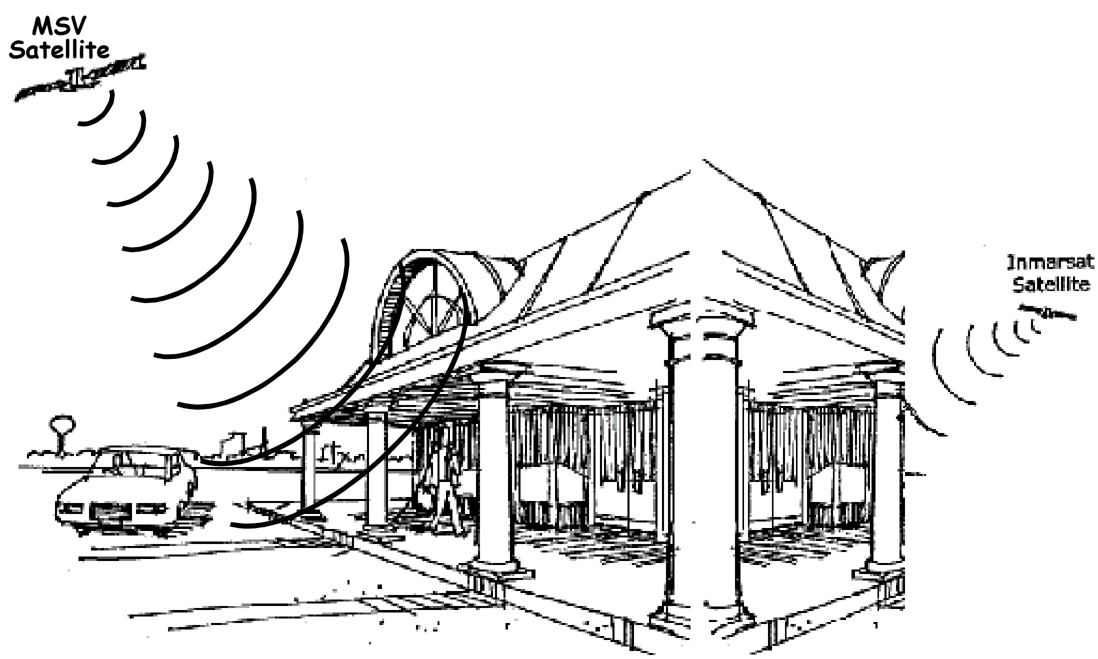
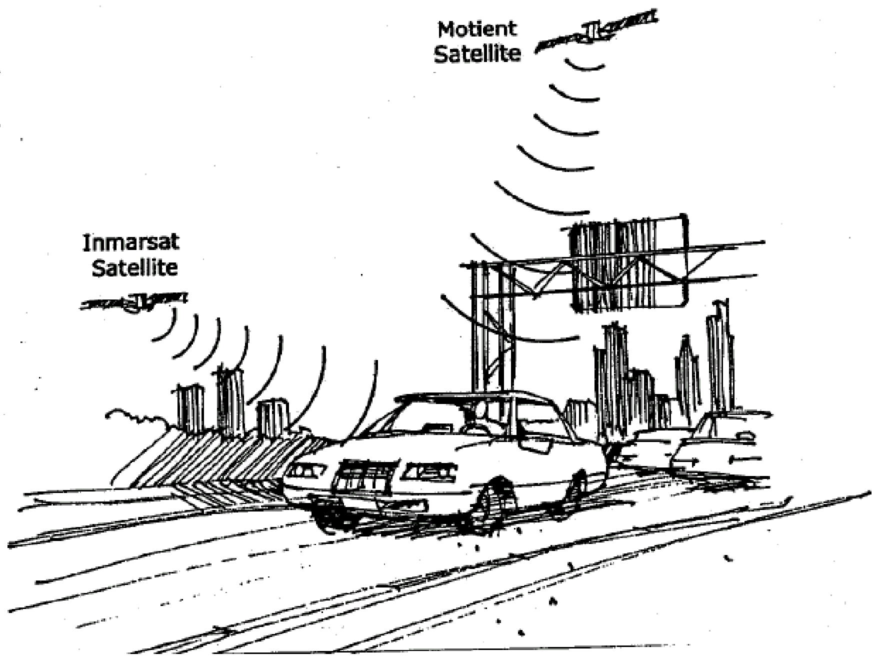
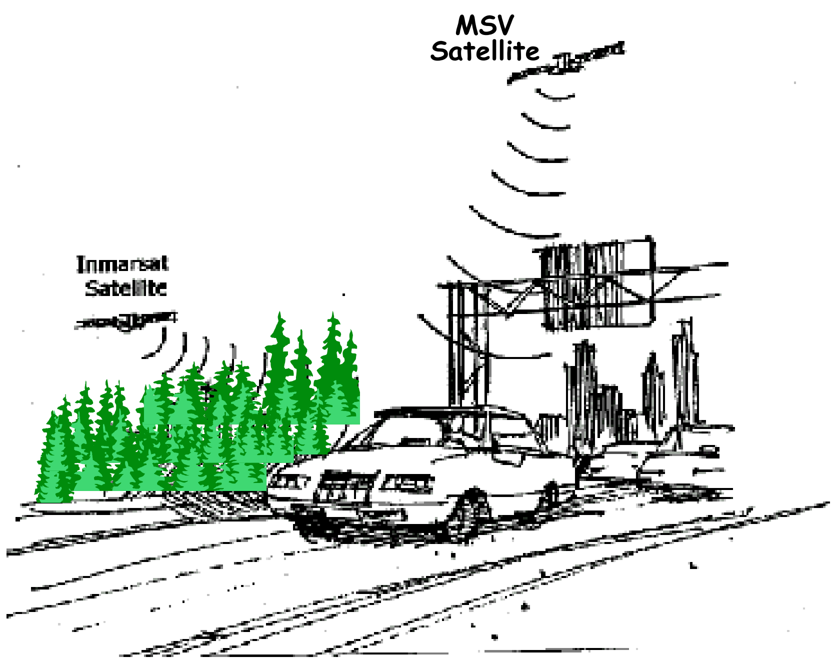


FIGURE 4: Top illustration provided by Inmarsat; bottom illustration courtesy of MSV



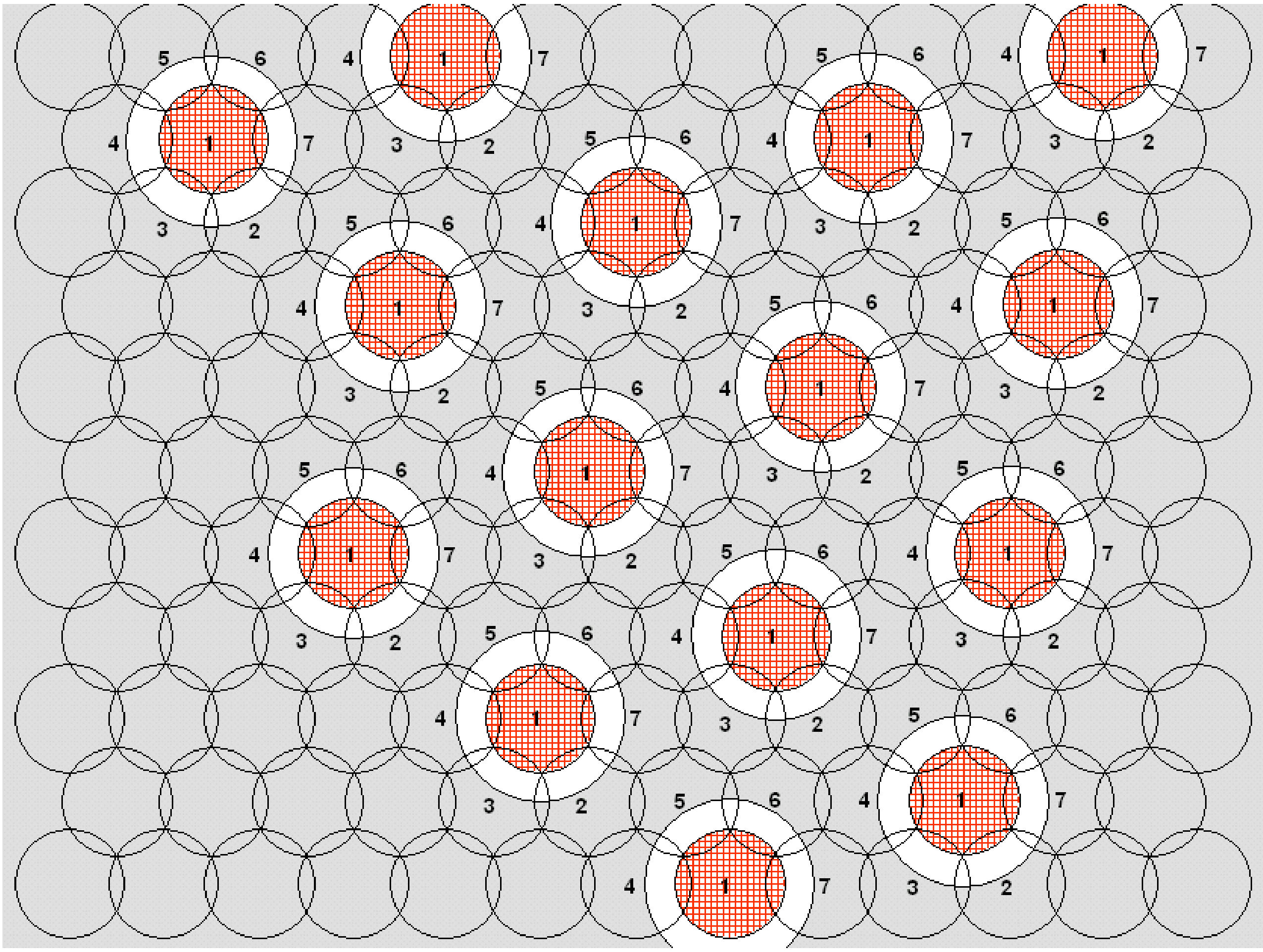


2. MSV's Intra-System Intra-Beam Monitoring Will Provide a Conservative Measure of ATC Emissions

Figure 5 illustrates an array of satellite cells as they project on the ground. Figure 5 also illustrates a seven-cell frequency reuse pattern that may be used by the satellite. All satellite cells labeled with the same number (e.g., all cells labeled as "1") reuse the same set of MSS frequencies. Outside of these satellite cells (labeled "1") and beyond the spatial guard bands shown in white, the frequencies used by cells "1" may be reused by the ATC. What makes this possible is a10 dB (average) satellite antenna discrimination that builds-up beyond the areas spanned by the white spatial guard bands (relative to the satellite antenna gain over the corresponding cell "1" regions).

Based on the above, and referring again to figure 5, it can be seen that all SS cells that contain ATCs, other than cells "1", may assign to their ATCs the frequencies used for SS communications by cells "1". Since satellite cells "2" through "7" use MSS frequencies other than those used by cells "1", emissions that cells "2" through "7" receive on frequencies corresponding to those being used by cells "1" may be attributed to ATC emissions. Because, however, cells "2" through "7" have borders with cells "1", cells "2" through "7" may inadvertently measure more than just the ATC emissions. Some of the power measured by cells "2" through "7" (over the frequencies that cells "1" are using for SS communications) may in fact be due to SS emissions taking place inside of cells "1" (intended for communications over MSV's SS). Furthermore, each set of cells "2" through "7" has borders with other such sets of cells that may be reusing the same frequencies for their ATC.

FIGURE 5: Illustration of frequency reuse by the satellite system and by the underlying ancillary terrestrial network



The circles in the above figure labeled with the number 1, represent satellite cells that are using and reusing a particular set of satellite band frequencies. This same set of satellite band frequencies may also be used and reused by the ATC over areas that coincide with urban centers located outside of the satellite cells labeled with the number 1, <u>and</u> also outside of the designated "white ring" exclusion regions. Each white ring area (exclusion region) represents a spatial guard band that allows the encircled satellite cell contour to develop an average discrimination of 10 dB relative to the urban areas that may reuse the frequency set used by the encircled satellite cell 1. (Each white ring exclusion region has a width of approximately □ to ½ of a satellite cell radius.)

3. Analysis

In its January 10, 2002 *Ex Parte* presentation to the Commission, MSV demonstrated that only 0.25 dB of link margin need be expended by its SS links to accommodate the (intra-system co-channel) effect of the ATC. The table below summarizes the analysis presented by MSV.

SS Link Margin Degradation to Accommodate Intra-System Effect of ATC

Parameter	Units	Values
Link Margin Degradation	**dB**	**0.25**
MSV Satellite Antenna Gain	dBi	41
MSV Satellite Receiver Noise Temperature	K	450
MSV Satellite Receiver Noise Spectral Density	dBW/Hz	-202.1
Maximum MSV Ancillary Terminal EIRP	dBW	0
MSV Terminal Carrier Bandwidth (ancillary mode)	kHz	200
MSV Terminal EIRP Spectral Density	dBW/Hz	-53.0
Free Space Loss	dB	188.8
Average Shielding	dB	10
MSV Satellite Receive Antenna Discrimination (Average)	dB	10
Average Power Reduction due to Closed-Loop Power Control	dB	6
Average Power Reduction due to Variable-Rate Vocoder	dB	7.4
Average Polarization Isolation (Linear to Circular)	dB	3
Voice Activity Factor	dB	1
Received Interfering Signal Spectral Density	dBW/Hz	-238.2
Max Number of Co-channel ATC Carriers per Co-channel Spot Beam Vicinity		244
Number of Users per Carrier		7
Maximum Number of ATC Users per Co-channel Spot Beam Vicinity		1,707
Number of Co-Channel Satellite Beam Vicinities over CONUS		~10
Total Number of Allowed Ancillary Co-Channel Carriers Over CONUS		**2,438**

3.1 Definition of "Satellite Cell Vicinity"

Every satellite cell[2] is surrounded by a region that we will call "a vicinity". For a seven-cell frequency reuse pattern (see Figure 5) the vicinity of a satellite cell lies within

[2] In the Table above, the term "spot beam" is used synonymously with the term "cell".

the surrounding area that is spanned by the six adjacent (neighboring) cells. Referring to Figure 5, we see that each cell "1" has a vicinity defined by cells "2" through "7". Not all of the area spanned by satellite cells "2" though "7" however, represents the vicinity of cell "1". The white ring exclusion region around cell "1", is not part of its vicinity.

3.2 Measurement Levels of Monitoring

As the above Table illustrates, if a satellite cell "1" is using frequency f_1, that same frequency f_1 may be reused by the ATC up to 244 times over the vicinity of cell "1" without imposing more than 0.25 dB of increased interference on the SS communications of cell "1". The entire area of the United States will contain approximately 10 such vicinities. Thus, over the whole US area up to 10 x 244 = 2,440 reuses of f_1 are possible with only a 0.25 dB penalty on MSV's SS link margin.[3]

Let us return now to the issue of monitoring. The power spectral density of the ATC emissions on frequency f_1 <u>aggregated</u> over the entire vicinity area spanned by cells "2" through "7" will be -204.3 dBW/Hz (or -151.3 dBW, integrated over the GSM carrier bandwidth of 200 kHz). This value is based on the parameters identified on the previous Table with the exception of the "antenna discrimination" value which is set to 0 dB (since the monitoring is intra-beam).[4] Thus, based on the parameters of the previous Table, when all 244 reuses of f_1 have been deployed by the ATC and are carrying traffic over

[3] In principle, all vicinities reusing f_1 will affect every satellite cell that is also using f_1. However, given the rapid built-up of the satellite antenna discrimination, the contribution of interference to SS links from ATC vicinities beyond the immediate one is negligible.

[4] Each cell that belongs to the vicinity (each one of the cells "2" through "7") performs a measurement of the power on frequency f_1. The six measurements from cells "2" through "7" are summed to yield the aggregate ATC interference of -204.3 dBW/Hz (based on the parameters given in the Table, but with the antenna discrimination value having been set to 0 dB).

the vicinity of cell “1”, monitoring of f_1 (over cells “2” through “7”) will reveal a noise plus ATC interference value of -204.3 “+” -194.3 = -193.9 dBW/Hz.[5]

We see that in the absence of ATC emissions the noise floor detected by monitoring will be at -194.3 dBW/Hz. The presence of ATC emissions, at a level that causes MSV’s satellite links to loose 0.25 dB of link margin, produces a 0.4 dB higher noise floor as seen by monitoring. The monitoring system will use logarithmic amplification to detect relatively small changes in noise floor. The monitoring system will also have the means to self-calibrate to the noise level in the absence of ATC emissions (this level of noise may be different at different times of the day).

[5] Note: -204.3 “+” -194.3 ≡ 10 log $[10^{-20.43} + 10^{-19.43}]$. The quantity -194.3 dBW/Hz represents the aggregate noise power spectral density (-202.1 + 10 log [6]).